The value of mass-digitised cultural heritage content in creative contexts

Original Research Article

BIG DATA & SOCIETY

Big Data & Society
January–June: 1–15

DOI: 10.1177/20539517211006165
journals.sagepub.com/home/bds
SAGE

The value of mass-digitised cultural heritage content in creative contexts

Melissa Terras[1], Stephen Coleman[2], Steven Drost[2], Chris Elsden[1], Ingi Helgason[3], Susan Lechelt[1], Nicola Osborne[1], Inge Panneels[3], Briana Pegado[4], Burkhard Schafer[1], Michael Smyth[3], Pip Thornton[1] and Chris Speed[1]

Abstract

How can digitised assets of Galleries, Libraries, Archives and Museums be reused to unlock new value? What are the implications of viewing large-scale cultural heritage data as an economic resource, to build new products and services upon? Drawing upon valuation studies, we reflect on both the theory and practicalities of using mass-digitised heritage content as an economic driver, stressing the need to consider the complexity of commercial-based outcomes within the context of cultural and creative industries. However, we also problematise the act of considering such heritage content as a resource to be exploited for economic growth, in order to inform how we consider, develop, deliver and value mass-digitisation. Our research will be of interest to those wishing to understand a rapidly changing research and innovation landscape, those considering how to engage memory institutions in data-driven activities and those critically evaluating years of mass-digitisation across the heritage sector.

Keywords

Digitisation, creative industries, cultural heritage, GLAM institutions, industrial strategy, entrepreneurship

This article is a part of special theme on Heritage in a World of Big Data. To see a full list of all articles in this special theme, please click here: https://journals.sagepub.com/page/bds/collections/heritageinworldbigdata

Introduction

How can those working in the creative and cultural industries best engage with large scale digitised content being delivered by Galleries, Libraries, Archives and Museums (GLAM)? How can those in the GLAM sector best engage with creatives and technologists to ensure digital resources are reused for social, cultural, economic and environmental benefit, in the development of new products and services? What are the implications of considering mass-digitised heritage content as a resource with economic value, to be further built upon? In this article, we consider the value of mass-digitised content, and reflect upon the implications in framing the digitisation of heritage content and spaces as a means for economic growth.

We use a case-study, Reflection-in-Action approach (Schon, 1983) providing examples from Creative Informatics (2018–2023), which aims to enhance data-sharing and innovation across the creative sectors throughout the City of Edinburgh and local regions,

[1]Creative Informatics, Edinburgh College of Art, University of Edinburgh, Edinburgh, UK
[2]Codebase, Edinburgh, UK
[3]Interaction Design Research Group, Edinburgh Napier University, Edinburgh, UK
[4]Fringe of Colour, Edinburgh, UK

Corresponding author:
Melissa Terras, University of Edinburgh, 56 George Square, Edinburgh, Midlothian EH8 9JU, UK.
Email: m.terras@ed.ac.uk

to develop ground-breaking new products, businesses and experiences, as part of the Creative Industries Clusters Programme (2020). We demonstrate that reuse of the products of digitisation is dependent on a complex landscape requiring access to levels of resourcing not normally seen within the cultural heritage sector. Reuse is also dependent on: accessing entry level data-skills training; the building of appropriate ethical and legal frameworks; and the establishment of digital preservation and data management infrastructure for innovation. When planning to build on digitised historical resources created for access, there is the need to reflect on tensions between novel technological solutions for social good, versus commercial or economic gain. Issues of data protection and privacy emerge even from historical datasets. Reframing digital cultural heritage as an asset changes its function, and we consider the ramifications for memory institutions. Finally, our findings are pertinent as the GLAM sector moves into post-COVID-19 online operationalising. As a result, this research will be of interest to those wishing to understand how best to engage the creative sectors, in particular GLAM institutions, in digital innovation that can drive forward commercial growth. However, we must also problematise the act of considering large scale digitised content as a resource to be further economically exploited, to inform how we consider, develop, resource, deliver and value mass-digitisation.

Digitisation and the Cultural Heritage Sector

Since the 1970s, GLAM institutions have been undertaking digitisation of their collections, using the affordances of digital networked infrastructure to improve the management of, increase engagement with, and access to collections (Hughes, 2004; Parry, 2010; Terras, 2011). There has been extensive investment into the mass-digitisation of cultural heritage from the 1990s (Lee, 2002: 160). GLAM institutions are now expected to host a proportion of their content online, and be engaging with the production of computational interactives, partly due to advancing user experiences of all digital media (Falk and Dierking, 2016: 122). Parallel to this is the increasing use of digital immersive technologies within major heritage sites and institutions (Pittock, 2018: 5).

However, despite this vast investment in cultural heritage digitisation, there has been little consideration of the *value* of mass-digitised content, to estimate and appraise it (Oxford English Dictionary, 2020). The broad value of the arts and heritage has been articulated: cultural experiences help shape reflective individuals, produce engaged citizens, impact cities and urban life, improve health and well-being and have distinctive economic benefits (Crossick and Kaszynska, 2016; Terras et al., 2014). More specifically, the traditional reasons given for mass-digitisation of heritage content include: increasing access to wider communities; supporting preservation; collections development; raising the profile of collections and institutions; and supporting research, education and engagement (Hughes, 2004: 8–17). Early research on the value of digitised content demonstrated that it broadened and reached new audiences (Finnis, 2011; Hughes, 2012), and could monetise demand for cultural heritage content (Bakhshi and Throsby, 2010: 15). More recently, the role of digitised content in 'digital civic innovation' has been considered, for 'social good' (Malde and Kennedy, 2018: 17). It has become clear that it is essential for heritage institutions to partake in digital cultural engagement to connect with audiences, co-create vision and operational approaches (a form of *values*), and successfully engage in the digital economy (Visser and Richardson, 2013). However, developing successful co-creation activities in GLAM institutions is arduous, and difficult when resources are scarce (Holdgaard and Klastrup, 2014). The use of generative computational routines, using digitised GLAM collections are source material for algorithmic composites, adds further nuance to evaluating digital access to and outputs of mass-digitisation (Whitelaw, 2019). Previous discussions, then, focus on the social potential and values of mass-digitised content, rather than economic values, in various ways.

Can mass-digitised content from the GLAM sector be valued as a resource for building new products and services? How best can memory institutions engage with this shift, given few have the resources to undertake technological research and development? There have been previous attempts to innovate in the GLAM sector space. Many institutions have adopted OpenGLAM principles (http://openglam.org): openly licensing content to strengthen their brand, disseminate content and encourage innovation (Sanderhoff, 2013; Terras, 2015a). The Edinburgh Festivals Innovation Lab (2012) encouraged sharing of festivals data for future research and innovation. British Library Labs provides prizes for research, commercial, artistic and teaching reuse of their digitised collections (British Library, 2019). The Library of Congress have encouraged reuse of collections via an Innovator in Residence Program (Library of Congress Labs, 2020). There is a movement conceiving openly available mass-digitised heritage content as 'collections as data', for analysis and innovation (Padilla, 2018). Unfortunately, though, many GLAM institutions have a fear of relinquishing control of data ownership (Tanner, 2004), and a 'fear of losing image licensing revenue' (Kapsalis, 2016). The GLAM sector has yet to invent business models to recover image fees that could be lost by open licensing, or giving others opportunities

to monetise GLAM content (Sanderhoff, 2013), although there have been some attempts. Print on demand services have been trialled where users can create and purchase products featuring artworks (Gorgels, 2013; Valeonti et al., 2019), or reuse design-related materials (National Archives, 2016).

However, although digitisation is now a widespread GLAM activity, 'memory institutions have not been able to fully adopt digital technology in order to become part of the information economy … to date, there is little known about the extent to which heritage organisations are able to innovate' (Borowiecki and Navarete, 2016: 227–228). There are emerging concerns regarding the growth of digital in the GLAM sector including: identifying, mapping and resolving the skills gap (Parry et al., 2018); navigating complex copyright frameworks (Terras, 2015b); governance, technical and ethical issues (Harrison et al., 2017); addressing the social purpose and meaning of digital cultural heritage (Malde and Kennedy, 2018); and addressing GLAM sector workforce imbalances in diversity, which affects all activities, including digital (Brook et al., 2020). While opportunities and ambition abound, further consideration is needed regarding how GLAM institutions should best engage with and contribute to data-driven technologies, and the implications of framing mass-digitised heritage as an innovation resource.

Co-creating value with digital GLAM

GLAM institutions are perpetually seeking novel ways to fund and sustain activities (Smets et al., 2018). These have yet to be considered through the lens of valuation studies (Helgesson and Muniesa, 2017), focusing on valuation *as a process*. Typically, GLAM initiatives are based upon the assumption that collections, estates and human resources are material, and value is conceived through the traditional lenses of the experience economy: collections of curated artefacts, that create value in different forms. Reflecting on the term *value* can identify the many GLAM forms it may take, before considering how datasets expand these notions. Over the past 20 years, Consumer Culture Theory and Service Dominant Logic have called for an expanded notion of the different concepts of value (Arnould and Thompson, 2005; Ng, 2012). Karababa and Kjeldgaard (2013, 2014) introduce seven concepts for value that span three meta categories: economic, semiotic and social. The seven are detailed as: exchange value; perceived value; social values and value systems; experiential value; identity and linking value; value as co-created; and finally value as the co-creation of meaning.

The economic foundations for the GLAM sector utilise Karababa and Kjeldgaard's (2014) *Exchange Value:* basic transactions in which goods or experience are 'exchanged' between two parties, such as paid exhibitions, gift shop merchandise, or café provision (Alexander, 1999). The *Social values and value systems* of GLAM are highly pertinent to the perceived value of institutions, driving footfall as visitors identify themselves as partaking in something socially good, such as increased understanding of knowledge and culture, affirming aspirations (Burton and Scott, 2003). Third is *Experiential Value*: GLAM experiences are expected to be enjoyable, allowing visitors to pursue fantasies, emotions and fun, reconciled against economic values by charged membership or blockbuster events (Alexander, 1999).

Whilst the previous three align with familiar GLAM concepts, access to data adds new dimensions. *Value as co-created* introduces the reciprocal push and pull between two or more parties to produce both economic benefits in the form of revenues and profits, but also emotional, symbolic and social values. Prior to use of website analytics, memory institutions had limited marketing insight as to what visitors valued, via periodic surveys and footfall counts. The advent of data-driven technologies has radically transformed the capability for GLAM to analyse what their audiences value, from online searches, impressions on webpages and metrics from review sites, resulting in the 'co-creation' of new experiences (Alexander et al., 2018). However, the GLAM sector has not yet grasped the implications recommender technology will have on its users (Wilson-Barnao, 2017). Finally, *Value as the co-creation of meaning* highlights the significant role visitors play in the creation of further symbolic forms of value, constructing new meanings and experiences for collections, beyond that intended (Romanelli, 2020). In order to do this, we have to conceive the 'collections as data' – accessible, malleable and supporting the ability for visitors to create their own meaning (Padilla, 2018). The opening up of datasets that previously lay behind firewalls extends the potential for the GLAM sector to reinvent its value: enabling external parties more agency to use data-driven technology to recast collections and co-create new meaning.

Encouraging growth in the creative industries

The creative industries have been viewed as engines of economic and social regeneration, particularly when resources are locally clustered (Evans and Shaw, 2004; Florida, 2014; Landry, 2012; NESTA, 2015, 2016, 2018). The 'Creative Industries' are defined by the UK's Department for Digital, Culture, Media & Sport (DCMS) as the 'those industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual

Figure 1. The National Library of Scotland's Tay and Forth Bridge photographic collections computationally reimagined, reinterpreting and reframing images of construction and disaster. Using GANs with mass-digitised content potentially opens up new avenues and markets for artworks. No title. © Martin Disley (2020), reproduced with permission.

property'. These include 'advertising, architecture, the art and antiques market, crafts, design, designer fashion, film and video, interactive leisure software, music, the performing arts, publishing, software and computer services, television and radio' recognising the 'close economic relationships with other sectors such as tourism, hospitality, museums and galleries, heritage and sport' (DCMS, 2001: 3). Within the UK context, research is now increasingly funded as part of a broader economic Industrial Strategy (Department for Business, Energy and Industrial Strategy (DBEIS), 2019). Funded partnerships are expected to have impact beyond academia (Research England, 2020). Resource in the UK is provided to 'act as a catalyst, driving innovation and growth across the UK's creative industries' encouraging 'a new type of applied research' (Creative Industries Clusters Programme, 2020: 3) with studies evaluating such initiatives (Schiach and Virani, 2017). However, much of this activity has not centred the digital, or data, which

is needed to build 'strong creative, digital and IT (CDIT) industries … [and] growth in terms of staff, products and sustainability' (Creative Fuse North East, 2019: 5). These developments have the potential to generate 'quadruple bottom line' impacts: environmental, social, economic and culturally beneficial (Scott, 2019). Culture is routinely missed out in most public policy (Wilson et al., 2020), although is supported by the Scottish Government National Performance Framework measures (https://nationalperformance.gov.scot). Growing digital within the Creative Industries is therefore a novel route to economic growth (Parkinson et al., 2020).

Examples of new value development

Creative Informatics (https://creativeinformatics.org, 2018–2023) is a major initiative encouraging data-sharing, innovation and digital opportunities across the creative sectors throughout the City of Edinburgh, and South East of Scotland Region, partnering with heritage organisations. Here we examine four Creative Informatics' projects that recall Karababa and Kjeldgaard's (2014) framework for value creation, centralising GLAM data in *value as co-created* and *value as the co-creation of meaning*. Each example is challenging for the organisation involved, seeks innovative responses to real-world issues, and demonstrates the potential for data-led innovation across the GLAM sector, drawing upon previously digitised content in unexpected ways.

Example 1: Reuse of cultural heritage data towards new products

Martin Disley's Resident Entrepreneur placement at the National Library of Scotland reuses cultural heritage data to generate new art products and services, as an exemplar for *value as the co-creation of meaning*. As a new media artist, Martin engages in novel digital methods, helping cultural institutions attract new audiences by visualising collections data. Through exploring the use of Generative Adversarial Networks (GANs) – a form of machine learning (see Wang et al., 2019), Disley created novel artworks based on the Library's large-scale digitised collections. For example, hundreds of openly licensed images of the Tay and Forth Bridges (National Library of Scotland, n.d.a, n.d.b) are reimagined as ghostly creations (Figure 1). Disley also utilised mass-digitised images of the Library's extensive map collection. While there is an increasing market for Artificial Intelligence (AI) generated artworks (Miller, 2019), Disley is also commercialising the process, exploring demand from GLAM institutions and licensing this approach (Disley, 2020, personal communication), thus producing a novel income-stream. Disley's aims to generate 'new digital image and video assets which successfully synthesise the contents of their digitised collections using generative machine learning technology; to deliver a public engagement solution through the exhibition of this new visual material; to develop an efficient pipeline for the application of this process to future clients collections' indicate an entirely new and unexpected reuse of mass-digitised content (Disley, 2020). Disley's co-created machine vision highlights different qualities and features in the collection, questioning their nature, uniqueness, features and how they were made. As a 'public engagement solution', this example suggests that by synthesising whole collections in this way, audiences are offered novel ways to approach and co-create the meaning of a collection.

Example 2: New XR productions building on digitised literature

The Edinburgh UNESCO City of Literature Trust (https://cityofliterature.com) who promote literary history is working with Bright White Ltd (http://www.brighwhiteltd.co.uk) and Offbeat Studios (https://www.offbeat.co.uk/) to explore how immersive gaming technologies can be used to develop a co-creative literary experience. The John Knox House, a 16th Century house that is one of the oldest in Edinburgh, will become the Literature House for Scotland, as part of an expanded Literary Quarter (https://ewh.org.uk/iconic-buildings-and-monuments/john-knox-house/). The project uses XR technologies (cross-reality) to create a proof of concept framework for immersive experiences, offering a new visitor-led modality of experience for literature. It provides a path towards more interactive, multi-modal and diverse experiences for visitors, while reusing digitised manuscript and crime fiction book content in a novel way, creating a bespoke (online and in situ) tourist attraction. The production of the associated code base, and substantial in-house testing and evaluation, should develop a new and proven workflow allowing productions that build upon digitised literature. Importantly, it is the scale of digitised content that allows personalised journeys to be constructed, and hence for visitors to establish their own experience. By presenting a visitor with data-driven choices while engaging with a collection, new approaches to its inherent values can be divined by the curator (and perhaps the technology provider).

Example 3: Repurposing digitised content for heritage site exploration

A project with Historic Environment Scotland (https://www.historicenvironment.scot) is developing an

interactive visitor experience to integrate their mass-digitised content within a reimagined tourist telescope. This will magnify and interpret landscapes at historic sites, enabling visitors to engage with HES monuments by providing historical data. This builds on substantial HES data assets including 3D reconstructions, film footage, laser scans and visualisations, archaeological and architectural data, historical photographs and user-generated content (see https://canmore.org.uk for their significant archive of 5 million digitised items). The project will implement the hardware and software of the history telescope, and raises issues including contactless transactions, sustainability by design, inclusivity and accessibility, as well as licensing, copyright and repurposing of digitised content. As in the prior example, by introducing a means for visitors to engage with services based on mass-digitised content, HES also generate a feedback loop that identifies and co-creates the value of the exhibit and the data behind it. Longer term, both Examples 2 and 3 become exemplars for Karababa and Kjeldgaard's (2014) concept of *Experiential Value,* whereby creating novel audience experiences underpinned by data, organisations can initiate new valuation processes and respond dynamically to audiences based on how they engage with their collections.

Example 4: Value as the co-creation of meaning at scale

The unexpected sudden switch to online for 2020 Festival season activities caused by the COVID-19 pandemic provided a space for Creative Informatics to creatively respond. Access to eight years of previous Edinburgh Fringe Festival programming data (via an API produced by the Edinburgh Festivals Innovation Lab (2012)) allowed a team from the University of Edinburgh to reuse 2.5 million words of previous show titles and descriptions, training an AI using a Long Short-Term Memory recurrent neural network (Karpathy, 2015). ImprovBot (https://improvbot.ai/) produced a new programme of algorithmically generated show descriptions, rolled out over the planned duration of the Fringe, with a daily online improvised comedy show undertaken by the resident student improv troupe, the Improverts (https://theimproverts.co.uk). The project delivered an unexpected digital elegy for a festival that did not take place in person, garnering rave reviews and much media coverage (ImprovBot, 2020). Although the planned in-person shows could not take place, the online project raises issues around the reuse and monetisation of previous programming information. ImprovBot enacts a new form of valuation process on this data, as it privileges certain features, themes and qualities over others, in order to generate show descriptions. Given AI will continue to intervene with digital records and heritage content in the co-creation of value (see Whitelaw, 2018, 2019), the ImprovBot aids the Edinburgh Fringe Society in extending its *social values and value systems* by exploring the reuse of its data. The project also demonstrates the potential for *value as the co-creation of meaning* at scale through the dynamic production of 350 'shows' that were distributed across social media. Attracting entirely new interpretations from a historical dataset, the project becomes an important coordinate for the GLAM community in understanding the potential for data-driven technology to produce new forms of value and experience, for both audience, creator and data holder.

These brief examples illustrate several ways in which mass-digitisation of collections, underpinned by new data-driven services, produce and reconfigure value. Most transparently, there are opportunities to render collections in new ways, providing novel means for audiences to experience and engage with them, co-creating new meaning. It is important to recognise that the use of data-driven approaches is itself a valuation process, as algorithms will explicitly prioritise certain collection features over others. By understanding this as a valuation process, we can be attuned to the values produced by such systems. Most provocatively, it is clear that feedback loops embedded within any data-driven service present rich opportunities to better understand audiences, and how they engage with cultural collections. This presents an opportunity to optimise exhibitions around what audiences prefer or appear to value; however, it also resurfaces critiques of services predicated on extracting value from audiences, and using that to determine future activities (Thatcher et al., 2016, Thylstrup, 2018; Zuboff, 2015). We suggest that by analysing how value is co-created, and not only exchanged, between GLAM organisations, audiences, publics, algorithms and technology companies, we can better identify such politics at play, and produce valuable cultural experiences which are beneficial to both audiences and institutions.

Reflection in action

At the end of our first year of operation, the Creative Informatics team engaged in Reflection-in-Action discussions, allowing us to identify 'features of the practice situation – complexity, uncertainty, instability, uniqueness and value conflict' (Schon, 1983: 18). An Action Research recursive methodology (Stringer, 2013) was used, considering: minutes from meetings; quarterly reports to funders; formal and informal evaluation reports; and cataloguing and recording activities. This facilitated the development and identification of

operational themes (Schon, 1983: 319; Stringer 2013: 142) which we expand on below, using our projects as exemplars. We then return to a discussion on the reframing of mass-digitised heritage content as a resource which can be used to create new aspects of value.

Emerging delivery issues

Training and upskilling

The publics' exposure to a variety of intangible cultures through social media, games and the internet has broadened discussions on the alignment of value (economic, social, environmental and cultural) with moral, ethical and societal values. GLAM communities are custodians of cultures from all of our pasts, held within both physical archives and databases. It is therefore important that they remain critical voices in discourse surrounding value, in particular regarding how it is co-created in many forms, through many modes of engagement. However, we identified a gulf between mass-digitised content and those who could build upon it. Funder terminology can be problematic: 'creative practitioners … have mostly never heard the phrase 'data-driven innovation' … when they do, it is more likely perceived on the very pragmatic terms of how recording, generating or processing data might contribute to their work or practice' (Lechelt et al., 2019: 2). AI based creative work requires new practices in terms of collecting, curating and archiving to reflect new modes of production and consumption (Graham, 2016). This is a future challenge for the GLAM sector (Harrison et al., 2017). Training and support is needed to build relationships that will allow data reuse. For example, in Disley's project, training and support on the High Performance Computing facilities at the University of Edinburgh was essential for artwork creation, as was support from the National Library of Scotland in order to utilise datasets. Upskilling and networking opportunities need to be designed alongside the creation of mass-digitised content as part of the delivery of digital materials, in order to encourage their uptake and to link disparate sectors, identifying skills gaps and responding in an agile manner (Parry et al., 2018). Unlocking any values in mass-digitised heritage data will require economic investment in skills (which may not be rewarded, see Holdgaard and Klastrup, 2014).

Data governance, law and ethics

The development of new business models in the creative industries is shaped by a rapidly evolving legal environment. 'Governance issues relating to privacy, ethics, provenance' are now key issues for data within GLAM (Harrison et al., 2017: 3). Mere legal compliance is insufficient to create social value. Various legislative regimes interact in complex ways with data-driven innovation, for instance disability law creates specific exceptions in copyright, which can impact digitisation strategies (Wallace, 2020). This requires adoption of ethical approaches to reuse of heritage data, developing principles from prior work (Floridi et al., 2018) to encompass the creative industries (Osborne et al., 2020). Such projects are likely to provide edge-cases that test limits of existing legal concepts and approaches, such as ImprovBot or Disley's work. The creation of economic value and meaning from the amalgamated attributes of other datasets is ethically problematic, and something that requires critical oversight (Amoore, 2020). Those encouraging creative reuse of large-scale heritage data need to establish robust approval, monitoring and governance processes which should be considered aspects of, rather than being separate to, mass-digitisation programmes. This will allow confidence in reuse, including unexpected interventions from creatives, and the ability to respond to archival content issues, particularly around the identification of individuals. For example, with ImprovBot, moderation was necessary when the AI regurgitated the names of real-life individuals. Again, extracting any additional value from heritage datasets will therefore require additional resource to navigate these complexities.

Copyright and IPR

A major issue in cultural heritage digitisation is copyright, and related legal mechanisms such as trademarks, design and Intellectual Property Rights (IPR). The onus is put upon individuals to understand and navigate a multifarious, international framework of rights management and licensing. For Historic Environment Scotland, rights to their and other's content must be navigated in a way which benefits creatives but also respects original material in the development of their history telescope. It has long been known that there is unequal access to the volume and quality of data available from GLAM organisations for those not associated with the institution, or without setting up commercial licensing agreements. The OpenGlam movement has been addressing this since 2012, to promote open data licensing of collections (OpenGlam, 2012; Terras, 2015a). However, the majority of mass-digitisation in cultural heritage is undertaken by commercial providers, and getting access to and permissions to reuse such data (e.g., the Edinburgh Fringe Festival Society programmes used by Improvbot) can be difficult. Additional issues regarding IPR are invoked when AI is used creatively in projects (Schafer, 2020), including generated revenue

flow, who owns the IPR of computationally generated works, and the legal roles and rights of computational intelligence. This is complicated further when it is unclear how data is used, manipulated, or generated by an AI: when using mass-digitised content, it may be impossible to articulate exactly which data was used, and how. We therefore need appropriate protocols to inform individuals and organisations about their responsibilities and rights in this area, but also to encourage a risk management approach (Korn, 2005; Stobo et al., 2017) to making data reuse possible. For example, it was not possible to contact all 80,000 previous Fringe shows to ask permission to reuse original programme listings for ImprovBot, but the risk of reputational damage to others was considered low. Emerging distributed ledger and blockchain technologies may offer new solutions for creative registries, through data-provenance and distributed documentation of the source and ownership of IPR and copyright. These may record how value can transform from economic to social capital and back again, or enable new monetisation models, challenging traditional copyright management protocols (Elsden et al., 2018; O'Dair, 2018). We recommend that projects aiming to encourage the reuse of digitised heritage content consider carefully how they will navigate these legal and emerging technological frameworks. Partnership agreements are particularly important where projects have an explicitly commercial outcome; however, this may, again, have resourcing implications.

Data management and digital preservation

The task of information governance (Smallwood, 2019) is crucial to manage data, to meet legal and ethical requirements and to encourage best practice, for all involved parties. Given that we are working across university institutions, and between industry and academia, this is complex (e.g., saving records of both Disley's and ImprovBot's algorithms, outputs and public engagements). Our Data Management Plan (DCC, 2013) has been openly published for transparency and to promote community uptake (Elsden et al., 2020). University approaches to data management will be different to those of creative businesses, and organisations that have created mass-digitised heritage content. Available institutional support should be relied upon, with transparent documentation, to encourage best practice and further reuse of data where possible. This aspect of data-reuse is also resource intensive.

Promoting creative reuse of digitised cultural heritage

Two Creative Informatics projects, Disley and ImprovBot, have already created new business models outside institutional contexts, representing the step-change in innovation we were tasked with. However, the gulf between now routine, GLAM service digitisation (Hughes, 2004; Nauta et al., 2017), and innovative, creative (and allowed) reuse of digitised content is large. In many cases, it is not clear how organisations ever intended their audiences to reuse mass-digitised heritage materials (Harrison et al., 2017: 3). Communication is needed to encourage creative businesses to consider mass-digitised content as a resource. This also requires reframing the rhetoric surrounding *why* entire heritage collections have been digitised. Business development support is needed, reframing established cultural economy activities (Schiach and Virani, 2017) around data. The way institutions describe and deliver mass-digitised datasets can mean they are neither discovered nor understood by non-GLAM audiences: this is an efficiency issue, given the resources that it takes to create them. Co-creation approaches with GLAM institutions and their expert staff that would describe, promote and broadcast the existence of datasets will attract both the technological and creative industries, while drawing on their own considerable technical, historical and social knowledge. Doing so will expand the traditional access and impact metrics now routinely associated with digitised heritage content (Finnis, 2011). However in a time of continued austerity for the sector, attempting to unlock the new values associated with these activities may not be a priority.

Labour and data in the creative industries

Technological innovation will impact the creative industries, and the longer-term implications of a more 'data-driven' cultural sector are unknown. While several of our projects look to algorithmic and machine-learning tools that can extend aspects of a creative process, others inject efficiencies. This raises questions about what is lost and gained through automation, and how creative labour that is replaced by such interventions will then be redistributed. Many workers will be required to learn digital approaches, creating new opportunities. However, these may change procedures, ownership and power dynamics, disrupting established processes and economies (Kerr, 2019) with potentially negative effects for both creatives and GLAM institutions. For example, data-driven services that valorise audience engagement could prioritise the most attention grabbing or superficial aspects of a collection, and diminish the value and importance of a curator's view in presenting a more nuanced story. The shift to large-scale automated services in other industries, especially social media and publishing, has required considerable human

moderation, to make value-based judgements about content (Gillespie, 2018; Ruckenstein and Turunen, 2020). Anticipating the labour involved in the many new models for the co-creation of value across the digital economies of GLAM is something that the sector should become sensitive to. If memory institutions are to centre trust and care for those they co-create with, they must be careful not to exploit them, and consider carefully when their audiences slip into becoming their workforce.

The commercial imperative

There is age-old tension between creativity and commercial or economic gain, with government (and various funding bodies) preferring income generating activities rather than considering the intrinsic value of cultural endeavours (Pratt, 2010). However, there remain differences between the need for continued technological development, the sustainability of outputs, and the goal of products and services to be designed for audience wellbeing, or for 'social good' (Malde and Kennedy, 2018). There has also been justified criticism regarding the use of creativity in urban and economic regeneration (Mould, 2016, 2018) and how participatory cultural initiatives can change dynamics of ecosystems (Biondi et al., 2020). The introduction of entrepreneurial activity to cultural spaces in the UK has often driven out core civic functions of organisations (Aroles et al., 2019).

Emerging business models in the creative industries often depend on experience economies that fetishize the live, personalised, novel, or performative moment (suitable for onwards social media sharing), creating further pressure on GLAM institutions to continuously transform or reimagine themselves in a crowded marketplace. The pursuit of technological novelty can be important for reputation and status (Miles and Green, 2008). However, GLAM institutions do not have the resources of major technology providers for research and development, and are not as easily able to recover from costly technological failures in design, delivery, or public relations. Additionally, much large scale digitisation has been funded, piecemeal, over the past 20 years, with phases of (often commercially) funded capture, with little thought to sustainability and connected growth. Ongoing resources are not available to consider these assets holistically, or to develop adequate business models around them. Previous license agreements may preclude them from being ever used in external creative endeavours.

Interesting innovations that *could* be fostered between the technology and creative industries may be purely imaginative, creative, beautiful, emotional, intelligent, or encouraging reflection, resilience and social or individual wellbeing. There is an emergent dialogue regarding the place of digitised cultural heritage in societal growth: 'How as cultural organisations can we make connections between wider societal issues and our own digital practices? How can we make sense of digital technologies as tools to help us respond to these social issues, and help us deliver on our social purpose, be more democratic and inclusive?' (Finnis, 2018: 2). However, these recent questions were not previously asked in the creation of mass-digitised heritage content, and hosts and providers rarely have the resources to begin reassessing datasets to respond to these fundamental issues of value. Undertaking such activities – or demanding GLAM institutions do – places unplanned burdens upon organisations, and necessitates a reframing of digital cultural heritage by GLAM professionals. The 'caring framework' (Wilson et al., 2020) might provide a useful way of understanding the cultural digital economy, where care is understood in creativity as a reciprocal relational activity, as would considering the value of GLAM institutions themselves, through the lens of valuation studies (Elsden et al., 2019; Helgesson and Muniesa, 2013).

These tensions can be thought of as 'creative frictions, rather than dilemmas' for GLAM leadership, encouraging thinking that 'not only eases potential tensions but paves the way to museums that are more intellectually interesting, economically sustainable, and socially inclusive' (Smets et al., 2018). In our role as funders of new creative products and services, Creative Informatics must also retain a fair and pragmatic approach that considers the viability and sustainability of the supported initiatives. Our ethics guidance (Osborne et al., 2020) provides perspectives on the multiple impacts that constitute success: not only economic sustainability but social, cultural and environmental benefits (the quadruple bottom line), which may be a useful approach for others in the cultural, creative and technology sectors. Through understanding data-driven innovation as presenting new and ongoing valuation processes, GLAM institutions could better recognise how different regimes of value are established, maintained and bridged, in their particular social context. Likewise, in the context of charity shops, Elsden et al. (2019) suggest the need for technologies that recognise a plurality of values, and afford new ways of translating between them to support the emergence of new social and economic relations.

Digital cultural heritage in a time of social distancing

The global COVID-19 pandemic has shown that digital content and infrastructures are increasingly essential, at a time when routine business and commercial frameworks have been disrupted or permanently destroyed,

particularly in the cultural and heritage sectors (Arts Council, 2020; Bakhshi, 2020; Creative Scotland, 2020). For example, the fact that the Edinburgh Festivals (one of our key partners) could not take place in person for the first time since 1947 will have lasting economic and social consequences (Linehan, 2020). Finding the means to generate new income streams and support innovative digital products is imperative for the survival of the creative industries, and, potentially, GLAM institutions themselves. The playful use of large data sets toward an OpenGLAM culture exposes new forms of value creation in which we may find the seeds to a more resilient COVID-19 recovery. However, tackling the issues raised here will need sectoral prioritisation and ongoing, long-term investment at a time of growing economic crisis (Parkinson et al., 2020). The necessary resources needed to create new value from digitised data-sets may be too difficult to acquire, or only accessible to some, at a time when heritage organisations are struggling to resource their basic functions.

Discussion

The reframing of mass-digitised cultural heritage content as source for economic growth within the creative industries, although a novel proposition at scale, is at odds with how digitisation programmes were established, funded, undertaken and expected to operate. Encouraging large scale reuse by the creative industries therefore clashes with certain sensibilities and decisions that were undertaken while in the phase of data creation (such as restricted licensing, or risk management approaches to copyright based on view-only access). The activities presented here, encouraging a much wider sense of reuse, are reminiscent of discussions in the early 2000s surrounding extending our understanding of digitised cultural heritage as an engagement tool, particularly in the light of web 2.0 (Finnis, 2011). We saw a sector move away from the static 'scan and dump' digitisation practices of the late 1990s, to one that began to place users at its heart. Can we begin this dialogue more fluently with the technological and creative sectors, to see mass-digitised content considered as a new data-source? Can we connect those who could possibly utilise this data to build new products and services with those who create, steward and sustain it? What then are the relationships then between the institution and the creative business: how could these be developed into mutually beneficial and symbiotic relationships? If institutions are allowing broad access to their digitised content under principles such as OpenGLAM, it is unclear how income streams will flow back to them.

The wider digital economy has evolved considerably, and with it consumer and cultural theories to explain how value is co-created. However, despite the GLAM sector having mass-digitised collections, it rarely has the resources to develop marketing or business strategies to experiment with new forms of digital economic development. To date Creative Informatics has engaged and instigated partnerships that provoke new forms of value creation, such as Disley's GAN and ImprovBot. Both projects offer insight toward the *co-creation of meaning* as their outcomes circulate social media and drive audiences to explore the origins behind the pieces that are produced 'by data' (Speed and Oberlander, 2016), or excite audiences about the value of datasets to play a part in contemporary culture. In contrast, projects with The Edinburgh UNESCO City of Literature Trust and Historic Environment Scotland that involve the development of data-driven 'instruments of experience', will *co-create value* through interactions with audiences, allowing visitors to gain more agency in the exploration of digitised archives, allowing them to ascribe their own value to collections.

Critical to the future of digital GLAM is the likely acceptance that institutions will no longer be able to control value within data economies. The value of datasets are not pre-determined, in a linear value chain, but open to co-creation by others in a value constellation (Normann and Ramirez, 1998; Speed and Maxwell, 2015), beyond the institutional context. In doing so, it is important to acknowledge the tensions that exist between innovative research and development, community participation and commercial imperatives, particularly in the cultural heritage space where digitisation is often carried out in conjunction with major profit-making publishers, such as Gale Cengage, ProQuest, or D.C. Thomson (Hauswedell et al., 2020; Thylstrup, 2018). Such data will not routinely be available for the type of activities we have discussed here, restricting further use by the creative industries. Contemporary critiques of technology companies and business models that are predicated on the extraction, capture and monopoly of large data sets (Thatcher et al., 2016; Zuboff, 2015) also relate to heritage data, including who has full access, or how user statistics are being monetised (Hauswedell et al., 2020). Clearly as new products, services and businesses emerge that are based on the value of GLAMs datasets, it will be important to reflect on how these contribute to and sustain a wider cultural ecosystem in practice. How can the GLAM sector ensure a level playing-field that both stimulates new creative work, and maintains broader public access and support? If GLAMs are unable to capitalise on the data-driven potential of their own digital assets, what risks are there that

these publicly available datasets are exploited by new digital intermediaries or become misrepresented by others? In this article, we have advanced examples and practices that acknowledge the range of values that the re-use and mass-digitation of cultural heritage content may offer. Looking forward clearly requires further attention to the 'value translations' that take place through data-driven innovation (Elsden et al., 2019), and how successfully these bridge competing economic and cultural concerns.

The GLAM sector must evolve by traversing new digital economies, whilst doing so in a culturally sensitive manner. Investment in upskilling staff with new technical developments is needed, as well as an awareness of the ethical challenges that the use of digitised heritage demands. The wider GLAM sector should be bold in the development of data infrastructures supporting access to creatives, to identify new patterns of meaning and value. Through the careful design of rights management and the introduction of data-driven technologies that reconfigure the labour involved in curating and designing with data, new opportunities arise as novel patterns and outputs can drive publics back to the library, gallery and museum to better understand the collections themselves. This, however, will all take resource, at a time of great austerity for the sector.

Conclusion

This article has reported from the early stages of the large-scale Creative Informatics programme using a Reflection-in-Action approach, to reflect upon the best way to unlock new value from large-scale cultural datasets. In many ways, it sets out more issues than it does successes or results: increased interaction with GLAM datasets will not happen without sustained encouragement and investment. However, attempts at reuse of mass-digitised content reveal a complex, interleaving, network of issues regarding training and upskilling, licensing and copyright, access to computational resources, access to data and consideration of the place of technological development within the cultural and creative sectors, and how that sits alongside existing or inherited activities, resources and cultural policy.

Most GLAM institutions, or related prospective partners within the creative industries, do not have the resources to carry out the range and types of activities that we have described here. However, this also lays bare the notion that data-driven innovation or creative reuse of digitised cultural heritage content can happen without adequate, sustained investment in GLAM, at a time of greatly reduced funding for the sector after years of austerity. In order to facilitate such efforts, professionals from different commercial or institutional contexts have to be encouraged to co-create, and attempt technological innovation in a low-risk manner. There is great potential contained within cultural heritage datasets, and the opportunities that such initiatives offer for a broad range of users of cultural heritage, including creatives, are vast. However, this article has laid out the complexities of what it takes to encourage reuse of previously digitised content to build new products, service and experiences, while attempting to generate new economic benefits, and different forms of value. These are barriers that need addressing: the pivot to digital via COVID-19 has revealed growing inequalities and issues with access to digitised and digital infrastructures, a need to redirect scant income streams and the inadequacy of online creative industries business models.

The legacy of 30 years of investment in cultural heritage digitisation is a patchwork of small to large scale content, held in different locations, formats and under different reuse licenses, with different institutional approaches to risk, public engagement and entrepreneurship. Here, we have scoped out the possibilities inherent in encouraging the technological and creative industries to access and build upon cultural heritage data, to explore the value of mass-digitised content in new and unexpected ways. However, we believe that this will remain a fairly niche activity without sustained structural help and investment, to encourage dialogue, collaboration and experimentation.

Acknowledgements

An early version of this article was presented at Digital Heritage in a World of Big Data Conference, University of Stirling, 14 May 2019. We thank the Creative Informatics project directors, delivery team, industrial partners and community for their contributions.

Declaration of conflicting interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Melissa Terras is a Trustee of the National Library of Scotland: all relevant activities obtained ethical approval from the University of XXXXX and the National Library of Scotland, and Author was not responsible for allocating their funding.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work is funded by the AHRC Creative Industries Clusters Programme, with support from the Scottish Funding Council and the Edinburgh and South East Scotland City Region Deal, Award Reference AH/S002782/1.

ORCID iDs

Melissa Terras https://orcid.org/0000-0001-6496-3197

Ingi Helgason https://orcid.org/0000-0002-0400-6421
Susan Lechelt https://orcid.org/0000-0002-8644-5646
Nicola Osborne https://orcid.org/0000-0003-2666-6321
Pip Thornton https://orcid.org/0000-0001-5049-1459

References

Alexander VD (1999) A delicate balance: Museums and the market-place. *Museum International* 51(2): 29–34.

Alexander VD, Blank G and Hale SA (2018) TripAdvisor reviews of London museums: A new approach to understanding visitors. *Museum International* 70(1–2): 154–165.

Amoore L (2020) *Cloud Ethics: Algorithms and the Attributes of Ourselves and Others*. London: Duke University Press.

Arnould EJ and Thompson CJ (2005) Consumer culture theory (CCT): Twenty years of research. *Journal of Consumer Research* 31(4): 868–882.

Aroles J, Hyde P and Hassard JS (2019) 'Culture for Sale': The effects of corporate colonization on the UK Museum Sector. In: Academy of management proceedings. Vol. 2019, No. 1. New York: Academy of Management.

Arts Council (2020) Covid-19 Support. Available at: https://www.artscouncil.org.uk/covid19

Bakhshi H (2020) Capturing the impact of COVID-19 on the creative industries. Nesta, Creative Economy and Culture, 31 March. Available at: https://www.nesta.org.uk/blog/capturing-impact-covid-19-creative-industries/

Bakhshi H and Throsby D (2010) *Culture of innovation. An economic analysis of innovation in arts and cultural organisations*, June, Nesta Research Report. London: Nesta. Available at: https://media.nesta.org.uk/documents/culture_of_innovation.pdf

Biondi L, Demartini P, Marchegiani L, et al. (2020) Understanding orchestrated participatory cultural initiatives: Mapping the dynamics of governance and participation. *Cities* 96: 102459.

Borowiecki KJ and Navarrete T (2016) Digitization of heritage collections as indicator of innovation. *Economics of Innovation and New Technology* 26(3): 227–246.

British Library (2019) British Library Labs. Available at: https://www.bl.uk/projects/british-library-labs

Brook O, O'Brien D and Taylor M (2020) *Culture is Bad for You, Inequality in the Cultural and Creative Industries*. Manchester: Manchester University Press.

Burton C and Scott C (2003) Museums: Challenges for the 21st century. *International Journal of Arts Management* 56–68.

Creative Fuse North East (2019) Project report 2019. Available at: http://www.creativefusene.org.uk/wp-content/uploads/2019/02/Creative-Fuse-Project-Report-2019-final.pdf

Creative Industries Clusters Programme (2020) The creative industries clusters programme: The story so far. Available at: https://creativeindustriesclusters.com/wp-content/uploads/2020/02/Clusters-Booklet-Story-So-Far-V12-web.pdf

Creative Scotland (2020) New support for creative sector during COVID-19 outbreak. 27 March. Available at: https://www.creativescotland.com/what-we-do/latest-news/archive/2020/03/covid-19-impact-funds

DCC. (2013) *Checklist for a Data Management Plan. v.4.0*. Edinburgh: Digital Curation Centre. Available at: http://www.dcc.ac.uk/resources/data-management-plans

Department for Business, Energy and Industrial Strategy (DBEIS) (2019) Industrial strategy: The grand challenges. Outline of government grand challenges for the industrial strategy, 13 September. Available at: https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges

Department for Digital, Culture, Media & Sport (DCMS) (2001) *Creative industries mapping documents*. Technical Report. GOV.UK. Available at: https://www.gov.uk/government/publications/creative-industries-mapping-documents-2001

Disley M (2020) *Creative informatics, resident entrepreneurs programme final report*, 10 September 2020. Creative Informatics, University of Edinburgh, Edinburgh.

Edinburgh Festivals Innovation Lab (2012) Project Showreel, Summer 2010–2012. Edinburgh Festival City. Available at: https://www.edinburghfestivalcity.com/assets/000/000/356/festivalslab_ProjectShowreel_external_v1-0_original.pdf?1411049766

Elsden C, Lechelt S, Thornton P, et al. (2020) 'Creative informatics research ethics overview. *Zenodo*. Available at: https://doi.org/10.5281/zenodo.3967216

Elsden C, Manohar A, Briggs J, et al. (April 2018) Making sense of blockchain applications: A typology for HCI. In: *Proceedings of the 2018 CHI conference on human factors in computing systems*, pp. 1–14. Available at: https://dl.acm.org/doi/pdf/10.1145/3173574.3174032

Elsden C, Symons K, Bunduchi R, et al. (2019) Sorting out valuation in the charity shop: Designing for data-driven innovation through value translation. In: *Proceedings of the ACM on human–computer interaction, 3(CSCW)*, The 22nd ACM Conference on Computer-Supported Cooperative Work and Social Computing, Austin, Texas, 9–13 November 2019, pp. 1–25.

Evans G and Shaw P (2004) *The Contribution of Culture to Regeneration in the UK: A Review of Evidence*. London: DCMS, p. 4.

Falk JH and Dierking LD (2016) *The Museum Experience Revisited*. Abingdon: Routledge.

Finnis J (2011) *Let's get real 1: How to evaluate success online*. Culture24, Brighton, UK. Available at: https://www.keepandshare.com/doc/3148918/culture24-howtoevaluateonlinesuccess-2-pdf-september-19-2011-11-15-am-2-5-meg?da = y&dnad = y

Finnis J (2018) Foreword. In: Malde S and Kennedy A (eds) Connecting Digital Practice with Social Purpose. Let's Get Real 6. Culture24, Brighton, UK. Available at: https://www.keepandshare.com/doc/8226734/let-s-get-real-6-culture-24-rgb-single-page-pdf-10-5-meg?da = y

Florida R (2014) *The Rise of the Creative Class Revisited*, New York, NY: Basic Books.

Floridi L, Cowls J, Beltrametti M, et al. (2018) AI4People – An ethical framework for a good AI society: Opportunities, risks, principles, and recommendations. *Minds and Machines* 28(4): 689–707.

Geoffrey C and Kaszynska P (2016) *Understanding the value of arts and culture. The AHRC Cultural Value Project*. Arts and Humanities Research Council. Available at: https://ahrc.ukri.org/documents/publications/cultural-value-project-final-report/

Gillespie T (2018) *Custodians of the Internet: Platforms, Content Moderation, and the Hidden Decisions That Shape Social Media*. New Haven, CT: Yale University Press.

Gorgels P (2013) Rijksstudio: Make your own masterpiece!. Available at: https://mw2013.museumsandtheweb.com/paper/rijksstudio-make-your-own-masterpiece/

Graham B (2016) New media art exhibition histories and futures: Participation, audiences, documentation, collection. In: A Companion to Digital Art. New York: Blackwell Companions to Art History. New York, NY: Wiley-Blackwell, pp. 575–596.

Harrison R, Morel H, Maricevic M, et al. (2017) *Heritage and data: Challenges and opportunities for the Heritage Sector*. Report of the Heritage Data Research Workshop, British Library, London, UK, 23 June. Available at: https://heritage-research.org/app/uploads/2017/11/Heritage-Data-Challenges-Opportunities-Report.pdf

Hauswedell T, Nyhan J, Beals MH, et al. (2020) Of global reach yet of situated contexts: An examination of the implicit and explicit selection criteria that shape digital archives of historical newspapers. *Archival Science* 20: 139–165.

Helgesson CF and Muniesa F (2013) For what it's worth: An introduction to valuation studies. *Valuation Studies* 1(1): 1–10.

Holdgaard N and Klastrup L (2014) Between control and creativity: Challenging co-creation and social media use in a museum context. *Digital Creativity* 25(3): 190–202.

Hughes LM (2004) *Digitizing Collections: Strategic Issues for the Information Manager*. London: Facet Publishing.

Hughes LM (ed.) (2012) *Evaluating and Measuring the Value, Use and Impact of Digital Collections*. London: Facet Publishing.

ImprovBot (2020) Press and coverage. Available at: https://improvbot.ai/about/press-and-coverage/

Kapsalis E (2016) The impact of open access on galleries, libraries, museums, & archives. Available at: http://siarchives.si.edu/sites/default/files/pdfs/2 016_03_10_ OpenCollections_Public.pdf

Karababa E and Kjeldgaard D (2013) Value marketing: Toward sociocultural perspectives. *Marketing Theory* 14 (1): 119–127.

Karababa E and Kjeldgaard D (2014) Value in marketing: Toward sociocultural perspectives. *Marketing Theory* 14(1): 119–127.

Karpathy A (2015) The unreasonable effectiveness of recurrent neural networks. In: Andrej Karpathy Blog, 21 May. Available at: http://karpathy.github.io/2015/05/21/rnn-effectiveness/

Kerr A (2019) Game production logics at work: Convergence and divergence. In: Making Media. Production, Practices, and Professions. Amsterdam: Amsterdam University Press, pp. 413–426.

Korn N (2005) Guide to intellectual property rights and other legal issues. Available at: http://www.minervaeurope.org/publications/guideipr1_0. pdf

Landry C (2012) *The Creative City: A Toolkit for Urban Innovators*. London: Earthscan.

Lechelt S, Elsden C, Helgason I, et al. (November, 2019) How can we balance research, participation and innovation as HCI researchers?. In: *Proceedings of the halfway to the future symposium 2019*, HTTF 2019: Halfway to the Future, Nottingham: United Kingdom, November, 2019. pp. 1–4. Available at: https://dl.acm.org/doi/10.1145/3363384.3363394

Lee S (2002) *Digital Imaging, a Practical Handbook*. London: Facet Publishing.

Library of Congress Labs (2020) Innovator in Residence Program. Available at: https://labs.loc.gov/about/opportunities/innovator-in-residence-program

Linehan F (2020) A message from our Festival Director. Edinburgh International Festival, 1 April. Available at: https://www.eif.co.uk/festival-guide/news-and-blogs/a-message-from-our-festival-director

Malde S and Kennedy A (eds) (2018) *Connecting digital practice with social purpose:* Let's get Real 6. Culture24, Brighton, UK. Available at: https://www.keepandshare.com/doc/8226734/let-s-get-real-6-culture-24-rgb-single-page-pdf-10-5-meg?da = y

Miles I and Green L (2008) *Hidden innovation in the creative industries*. Nesta Research Report, July. Available at: https://e-space.mmu.ac.uk/624532/1/hidden_innovation_creative_industries_report.pdf

Miller AI (2019) "But Is It Art?": GANs enter the art market. In: The Artist in the Machine: The World of AI-Powered Creativity. Boston, MA: MIT Press, pp. 119–122.

Mould O (2016) Mediating the city: The role of planned media cities in the geographies of creative industry activity. In: Hub Cities in the Knowledge Economy: Seaports, Airports, Brainports, pp. 163–180.

Mould O (2018) *Against Creativity*. London: Verso Books.

National Archives (2016) The design collection. Available at: https://design.nationalarchives.gov.uk/; see copy in the UK Web Archive https://webarchive.nationalarchives.gov.uk/20150417232005; https://design.nationalarchives.gov.uk/

National Library of Scotland (n.d.a) Photographs from the Tay Bridge enquiry. Available at: https://www.flickr.com/photos/nlscotland/albums/72157625277647185

National Library of Scotland (n.d.b) Construction of the Forth Bridge illustrations 1886–1887. Available at: https://www.flickr.com/photos/nlscotland/sets/72157625399050306/

Nauta GJ, van den Heuvel W and Teunisse S (2017) D4.4 report on ENUMERATE core survey 4. Europeana DSI 2 – Access to Digital Resources of European Heritage, Europeana.

NESTA (2015) *The geography of the UK's creative and high tech economies*. Available at: https://media.nesta.org.uk/documents/geography_uks_creative_high-tech_economieswv20151.pdf (accessed 2 April 2020).

NESTA (2016) *The geography of creativity*. Available at: https://media.nesta.org.uk/documents/the_geography_of_creativity.pdf (accessed 2 April 2020).

NESTA (2018) *Creative nation*. Available at: https://www.nesta.org.uk/report/creative-nation/ (accessed 2 April 2020).

Ng I (2012) *Value and Worth: Creating New Markets in the Digital Economy*. Cambridge: Innovorsa Press.

Normann R and Ramirez R (1998) *Designing Interactive Strategy: From Value Chain to Value Constellation*. Chichester: John Wiley & Sons.

O'Dair M (2018) *Distributed Creativity: How Blockchain Technology will Transform the Creative Economy*. New York, NY: Springer.

Oxford English Dictionary (2020) "value, v.". In: *Oxford English Dictionary Online*, December. Oxford: Oxford University Press. Available at: https://www.oed.com/view/Entry/221254?result=2&rskey=J1KaN8& (accessed 11 January 2021).

OpenGlam (2012) OpenGlam.org. Available at: https://web.archive.org/web/20200103233415; https://openglam.org/ (accessed 11 January 2012).

Osborne N, Schafer B and Terras M (2020) Creative informatics ethics statement, *Zenodo*, 16 January. Available at: http://doi.org/10.5281/zenodo.3610105

Padilla TG (2018) Collections as data: Implications for enclosure. *College & Research Libraries News* 79(6): 296.

Parkinson C, Terras M, Speed C, et al. (2020) Developing data-driven innovation in creative industries. White paper. In: Data-Driven Innovation. Available at: https://doi.org/10.7488/era/507

Parry R (2010) *Museums in a Digital Age*. Abindgon: Routledge.

Parry R, Eikhof DR, Barnes SA, et al. (2018) Development, supply, deployment, demand: Balancing the museum digital skills ecosystem. First findings of the 'One by One' national digital literacy project. *Museums and the Web 2018*. Available at: https://mw18.mwconf.org/paper/development-supply-deployment-demand-balancing-the-museum-digital-skills-ecosystem-first-findings-of-the-one-by-one-national-digital-literacy-project/

Pittock M (2018) *The Scottish heritage partnership immersive experiences: Policy report*. University of Glasgow, UK. Available at: http://eprints.gla.ac.uk/198201/1/198201.pdf.

Pratt AC (2010) Creative cities: Tensions within and between social, cultural and economic development: A critical reading of the UK experience. *City, Culture and Society* 1(1): 13–20.

Research England (2020) Knowledge exchange framework (KEF). Available at: https://re.ukri.org/knowledge-exchange/knowledge-exchange-framework/

Romanelli M (2020) Museums and technology for value creation. In: Strandgaard Pedersen J, Slavich B and Khaire M (eds) *Technology and Creativity*. Cham: Palgrave Macmillan, pp. 181–210.

Ruckenstein M and Linda Lisa Maria T (2020) Re-humanizing the platform: Content moderators and the logic of care. *New Media & Society* 22(6): 1026–1042.

Sanderhoff M (2013) Open images. Risk or opportunity for art collections in the digital age?. *Nordisk Museologi* 2013 (2): 131–146.

Schafer B (2020) The man who wasn't there again: Creative informatics and legal AI. In: Hoetzendorfer W, Tschohl C and Kummer F (eds) *International Trends in Legal Informatics: Festschrift für Erich Schweighofe*. Bern: Weblaw AG, pp. 293–320.

Schiach M and Virani T (2017) Cultural policy, innovation and the creative economy. In: *Creative Collaborations in Arts and Humanities Research*. London: Palgrave Macmillan.

Schon DA (1983) *The Reflective Practitioner: How Professionals Think in Action*. New York, NY: Basic Books.

Scott J (2019) *Funding creativity: An internal research and discussion paper to inform creative Scotland's funding review options appraisal* (Abbreviated). Prepared for Creative Scotland by Jeanie Scott, Culture Radar, March. Available at: https://www.creativescotland.com/__data/assets/pdf_file/0008/66869/Funding-Creativity-Research-Review-of-International-Funding-Models-FINAL-v2.pdf

Smallwood RF (2019) *Information Governance: Concepts, Strategies and Best Practices*. Chichester: John Wiley & Sons.

Smets M, Moos C, Shaw L, et al. (2018) *Museum leaders' report*. University of Oxford, UK. Available at: https://www.glam.ox.ac.uk/sites/default/files/glam/documents/media/the_museum_leaders_report.pdf

Speed C and Maxwell D (2015) Designing through value constellations. *Interactions* 22(5): 38–43.

Speed C and Jon O (2016) Designing from, with and by Data: Introducing the ablative framework. In *Proceedings of the International Design Research Society Conference*.

Stobo V, Patterson K, Deazley R, et al. (2017) Digitisation and risk. *EThOS* 3(5): 15.

Stringer ET (2013) *Action Research*. 4th ed. London: Sage Publications.

Tanner S (2004) *Reproduction Charging Models & Rights Policy for Digital Images in American Art Museums: A Mellon Foundation Study*. London: KDCS Digital Consultancy.

Terras M (2011) The rise of digitization. In: Rikowski R (ed.) Digitisation Perspectives. Rotterdam: Sense Publishers, pp. 3–20.

Terras M (2015a) Opening access to collections: The making and using of open digitised cultural content. *Online Information Review* 39(5): 733–752.

Terras M (2015b) So you want to reuse digital heritage content in a creative context? Good luck with that. *Art Libraries Journal* 40(4): 33–37.

Terras M, Priego E, Liu A, et al. (2014) The humanities matter! Infographic. Available at: https://4humanities.org/wp-content/uploads/2013/07/humanitiesmatter300.pdf

Thatcher J, O'Sullivan D and Mahmoudi D (2016) Data colonialism through accumulation by dispossession: New metaphors for daily data. *Environment and Planning D: Society and Space* 34(6): 990–1006.

Thylstrup N (2018) *The Politics of Mass Digitisation*. Cambridge MA: MIT Press.

Valeonti F, Terras M, Hudson-Smith A, et al. (2019) Examining mobile print-on-demand as an alternative to image licensing for monetising digitisation to promote OpenGLAM. *Museums and the Web, Boston*, 2–6 April 2019.

Visser J and Richardson J (2013) *Digital engagement in culture, heritage and the arts*. Asimetrica report. Available at: https://www.asimetrica.org/wp-content/uploads/2014/11/Digital_engagement_in_culture_heritage_and_the_arts.1.pdf

Wallace A (2020) Accessibility and open GLAM. In: International Perspectives on Disability Exceptions in Copyright and the Visual Arts: Feeling Art. Abindgon: Routledge.

Wang Z, She Q and Ward TE (2019) Generative adversarial networks in computer vision: A survey and taxonomy. *arXiv preprint* arXiv:1906.01529.

Whitelaw M (2018) Mashups and matters of concern: Generative approaches to digital collections. *Open Library of Humanities* Available at: https://olh.openlibhums.org/articles/10.16995/olh.291/

Whitelaw M (2019) Succession: A generative approach to digital collections. In: Lewi H, Smith W, vom Lehn D, et al. The Routledge International Handbook of New Digital Practices in Galleries, Libraries, Archives, Museums and Heritage Sites. London: Routledge. Available at: https://doi.org/10.4324/9780429506765.

Wilson N, Gross J, Dent T, et al. (2020) *Re-thinking Inclusive and Sustainable Growth for the Creative Economy: A Literature Review*. DISCE Publications, King's college London: London. Available at: https://disce.eu/wp-content/uploads/2020/01/DISCE-Report-D5.2.pdf

Wilson-Barnao C (2017) How algorithmic cultural recommendation influence the marketing of cultural collections. *Consumption Markets & Culture* 20(6): 559–574.

Zuboff S (2015) Big other: Surveillance capitalism and the prospects of an information civilization. *Journal of Information Technology* 30(1): 75–89.